Grafting of Interpenetrating Networks of Two Stimuli-responsive Polymers onto PP

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In this work a new strategy was used to prepare interpenetrating polymer networks (IPNs) of two "stimuli-responsive" polymers: a thermosensitive poly N-isopropylacrylamide (PNIPAAm) and pH sensitive poly acrylic acid (PAAc), the last grafted onto PP films. IPNs are a combination of two or more polymers in network form, which are mixed together (not chemically but physically), with al least one such polymer polymerized and/or crosslinked in the immediate presence of the other(s). The "stimuli-responsive" polymers, also called "smart" polymers, exhibit relatively large and sharp physical or chemical changes in response to small physical or chemical stimuli. These polymers are being used as hydrogels or copolymers for technical applications in chemical and mechanical engineering systems such as mass separation, chemical valves, temperature or pH indicators, biomedical and drug delivery systems. For these applications a rapid response and good mechanical properties are necessary. Formerly [1] when PNIPAAm and PAAc were chemically combined their sensitivity was often altered or eliminated and their copolymer had poor mechanical properties. Attempts to solve this problem by creating IPN`s with a reduced gel size or by using a macro-porous structure were successful in preserving sensitivity but failed to produce adequate mechanical properties.

The object of this paper is to improve the past results of using a binary graft of PNIPAAm and PAAc onto poly(tetrafluoroethylene) PTFE [2]. Poly acrylic acid was grafted onto polypropylene films (with good mechanical properties) by gamma radiation in air (pre-irradiation method), then these grafts were crosslinked using any of the next two methods: The first one, the grafted film in water and argon atmosphere by gamma radiation; and the second one, in the same conditions, but adding a crosslinking agent N, N'-methylenebisacrylamide (MBAAm). The second network was carried out *in situ*, in the cross-linked PAAc grafted onto PP films, by chemical polymerization and crosslinking of NIPAAm: with a crosslinking agent (MBAAm), N, N, N',N'-tetramethylethylenediamine (TEMED) and ammonium persulfate (APS) as redox initiator. With the synthesis of the last network, we have new films which are a full IPN grafted onto PP: *net*-(PP-g-PAA)-*inter-net*-PNIPAAm, synthesized in three steps. These films were characterized in their thermal and pH properties (limited swelling, contact angle, pH "cloud point" and LCST), chemical composition (FTIR), thermal properties (DSC and TGA) and morphology (SEM).

[1] A. S. Hoffman. Macromol. Symp. 98 (1995) 645-663
[2] O. Palacios, R. Aliev, G. Burillo, Polymer Bull. 51 (2003) 191-197.

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